

# K X-Ray Energies and Transition Probabilities for He-, Li- and Be-like Praseodymium ions

J. P. Santos<sup>\*1</sup>, A. M. Costa<sup>†</sup>, M. C. Martins<sup>\*</sup>, P. Indelicato<sup>§2</sup>, F. Parente<sup>\*3</sup>

<sup>\*</sup> Centro de Física Atómica, CFA, Departamento de Física, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal

<sup>†</sup> Centro de Física Atómica, CFA, Departamento de Física, Faculdade de Ciências, FCUL, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal

<sup>§</sup> Laboratoire Kastler Brossel, École Normale Supérieure, CNRS, Université P. et M. Curie – Paris 6, Case 74; 4, place Jussieu, 75252 Paris CEDEX 05, France

**Synopsis** Theoretical transition energies and probabilities for He-, Li and Be-like Praseodymium ions are calculated in the framework of the multi-configuration Dirac-Fock method (MCDF), including QED corrections. These calculated values are compared to recent experimental data obtained in the Livermore SuperEBIT electron beam ion trap facility [1].

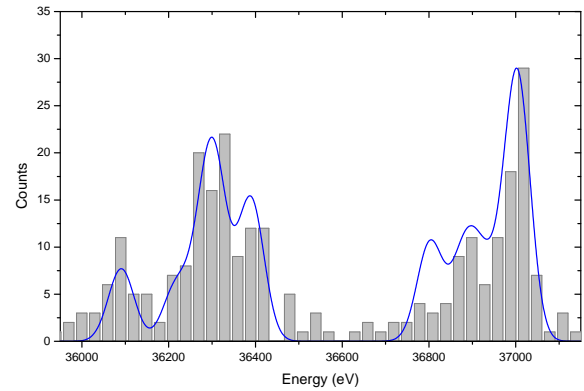
Highly-charged ions constitute a testbed for the understanding of the electronic structure of matter, because they can be considered a subclass of atoms in which the basic physical parameters take on extreme values.

In the present *ab initio* theoretical work we start from a Dirac-Fock calculation with Breit interaction included self-consistently. Higher-order retardation and one-electron radiative corrections are also included, and the screening of the self-energy is evaluated using the Welton approximation. Correlation is added within the multiconfiguration Dirac-Fock method (MCDF). In this framework we have calculated the relativistic transition energies for the most important He-like, Li-like, and Be-like Praseodymium K lines, and used them to compute the transition probabilities.

Using a preliminary calculation of excitation and ionization cross sections from the ions ground configurations, as in our earlier work for silicon ions [2], we were able to synthesize a theoretical spectrum, which was compared to experimental data obtained in the Livermore SuperEBIT electron beam ion trap facility [1].

The more important features in this spectrum are the He-like  $1s2s^3S_1 \rightarrow 1s^2^1S_0$  M1 line,  $1s2p_{1/2}^3P_1 \rightarrow 1s^2^1S_0$ , and  $1s2p_{3/2}^1P_1 \rightarrow 1s^2^1S_0$  E1 lines, the Li-like  $1s2s^2^2S_{1/2} \rightarrow 1s^22p_{1/2}^2P_{1/2}$  two-electron one-photon line, and

the  $1s2s2p_{3/2}^2P_{3/2} \rightarrow 1s^22s^2S_{1/2}$  E1 line.



**Figure 1.** Synthesized theoretical He-, Li- and Be-like Praseodymium spectrum compared with experimental data from Ref. [1].

For the He-like  $1s2s^3S_1 \rightarrow 1s^2^1S_0$  and  $1s2p_{3/2}^1P_1 \rightarrow 1s^2^1S_0$  line energies we obtained the values 36305.08 keV, and 37003.43 keV, respectively, in very close agreement with the values of the high-precision QED calculations from Ref. [3]. Despite the low statistics of the experimental data, our synthesized spectrum is able to account for most of its features. Complete results will be published elsewhere [4].

## References

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<sup>1</sup>E-mail: [jps@fct.unl.pt](mailto:jps@fct.unl.pt)

<sup>2</sup>E-mail: [paul.indelicato@spectro.jussieu.fr](mailto:paul.indelicato@spectro.jussieu.fr)

<sup>3</sup>E-mail: [facp@fct.unl.pt](mailto:facp@fct.unl.pt)